Remarks

Amendments to Specification

Applicants have amended the specification to correct typographical error in misspelling by replacing "silicone" with "silicon". Support for this amendment can be found on page 3, line 19; page 9, line 10; page 10, claim 1, lines 6 and 8; page 10, claim 5, line 18; page 10, claim 6, line 21; page 10, claim 8, line 26; page 11, claim 10, line 6; page 11, claim 13, line 20; page 11, claim 15, line 30; page 12, claim 19, lines 16 and 20; page 12, claim 21, line 26; page 13, claim 23, line 1; page 13, claim 25, line 11 and page 14, line 8.

Amendments to Claims

Claims 1-18 are pending. Claims 19-29 have been previously canceled under restriction requirement. Claims 1, 7, 8, 12, and 13 have been amended. Claims 5-6 have been canceled.

Claim 1 has been amended to delete "a fluorocarbon silane" as a sole source of the coating on the surface of the conduit. Thus, the conduit of Claim 1 is coated with a substantially aqueous emulsion as further defined therein. Claim 1 is further amended to delete the word "optionally" to specify the surfactant, the silicon compound and catalyst are required components for the emulsion.

Claims 7-8 have been amended to depend on Claim 3 and not on Claim 5 canceled herein. Claims 12 and 13 have been amended to depend on Claim 4 and not on Claim 6 canceled herein.

Claim Rejections – 35 U.S.C. § 102

Examiner has rejected Claims 1-2 under 35 U.S.C. § 102 (b) as being anticipated by Diaz (EP 0 195 292, hereinafter, "Diaz"). Examiner asserts Diaz discloses a conduit having its surface or a portion of its surface coated with a fluid repellent layer wherein said layer comprises or is produced from, a fluorocarbon silane, wherein said conduit is a nozzle (column 1, lines 28-65).

Applicants have amended Claim 1 to specify the conduit is coated with a layer which comprises or is produced from a substantially aqueous emulsion wherein said emulsion is produced from (1) a fluorocarbon silane or its hydrolyzate, (2) water, and (3) a surfactant, a silicon compound, and a catalyst. Therefore, Claims 1-2 are not anticipated by Diaz.

Claim Rejections – 35 U.S.C. § 103

Examiner has rejected Claims 3-18 under 35 U.S.C. § 103(a) as being unpatentable over Diaz in view of Iwato et al. (WO 01/90267, hereinafter, "Iwato"). Examiner admits Diaz fails to disclose an aqueous emulsion which comprises or is produced from a fluorocarbon silane or its hydrolysate, water, a surfactant, a silicon compound, a catalyst which is an acid or a base, wherein said fluorocarbon silane has the formula R_f-$(CH_2)_p$-Si{-$(O$-$CH_2CH_2)_n$-OR^1}$_3$; said silicon compound is a silicate or an organoalkoxy silane; R_f is a C_{3-18} perfluoroalkyl group or combinations of two or more thereof; each R^1 is independently one or more C_{1-3} alkyl groups; p is 2 to 4; and n is 2 to 10, wherein the surface is metal or ceramic.

Examiner asserts Iwato discloses an aqueous emulsion, said emulsion comprises or is produced from a fluorocarbon silane or its hydrolysate, water, a surfactant, a silicon compound, a catalyst which is an acid or a base, wherein said fluorocarbon silane has the formula R_f-$(CH_2)_p$-Si{-$(O$-$CH_2CH_2)_n$-OR^1}$_3$; said silicon compound is a silicate or an organoalkoxy silane; R_f is a C_{3-18} perfluoroalkyl group or combinations of two or more thereof; each R^1 is independently one or more C_{1-3} alkyl groups; p is 2 to 4; and n is 2 to 10, wherein the surface is metal or ceramic. Examiner further asserts Iwato discloses use of the emulsion as a coating for the purpose of providing improved heat resistance and water repellency properties. Applicants agree.

Examiner concludes it would have been obvious to one of ordinary skill in the art at the time Applicants' invention was made to have provided an aqueous emulsion as disclosed by Iwato in the coating of Diaz to provide improved heat resistance and water repellency properties as taught or suggested by Iwato. Applicants respectfully assert Iwato fails to teach or suggest coating a conduit with the emulsion described therein. Applicants assert the conduit as claimed provides benefits of abrasion resistance and resistance to alkalinity, which are properties neither taught nor suggested by Iwato. Applicants further assert there is no motivation to use the emulsion as disclosed by Iwato, that is used to coat glass windows of ovens, ranges, or toaster, for coating conduits. Applicants provide support for these assertions hereinbelow.

Iwato discloses the need for water-repellent and oil-repellent coatings on oven, range and toaster doors, that is, applications where coatings are exposed to high temperature, not abrasive or alkaline conditions. Iwato Application Examples and Comparative Examples, pages 6-14, disclose temperature stability of such compositions on metal and glass substrates. That is, testing involved exposure of coated substrates to high temperatures (330°C to 375°C) for various periods of time. While Iwato discloses use of such compositions as coatings, Iwato fails to disclose a coated conduit wherein said conduit is exposed to abrasive or alkaline conditions (such as exposure to inks in an ink jet nozzle).

Diaz (as well as Albinson, EP 0 367 438 B, hereinafter, "Albinson" and Griffin et al., WO 96/06895, hereinafter, "Griffin", disclosed by Applicants in Supplemental Information Disclosure Statement, dated May 20, 2004; and Nakagawa, et al., EP 1 386 951 A1, hereinafter, "Nakagawa" disclosed by Applicants in Second Supplemental Information Disclosure Statement, dated July 12, 2006) disclose coating conduits, such as those of ink jet nozzles and benefits of using particular coating compositions containing particular fluorocarbon silanes.

Diaz, Albinson, Griffin, and Nakagawa, disclose specific compositions that provide improvements over "conventional" compositions for the purpose of providing good adhesion to substrates, and good resistance to abrasive and alkaline conditions. That is, each of Diaz, Albinson, Griffin, and Nakagawa, teach that not all fluorocarbon-silane compositions, nor all silicon compounds, nor combinations thereof, provide the necessary properties for use in demanding environments such as ink jet nozzles. These documents teach that ejection of fluid, such as through an ink jet nozzle, is an abrasive process – the nozzle material as well as any coating thereon is subject to attack by the components of the ink – and that ink compositions are alkaline.

Diaz discloses a method for coating an ink jet nozzle plate with a fluorocarbon silane and a perfluorinated alkane using radio frequency glow discharge – the coating composition of Diaz and the method of coating the substrate both differ substantially from the composition and method of coating of Applicants' Claims. Applicants' coating is provided by a liquid phase (emulsion) coating process in contrast to the gas phase process of Diaz. Furthermore, the emulsion composition of Applicants' Claims includes components (silicon compound, surfactant, acid catalyst) not taught in Diaz whereas Diaz teaches use of a component (perfluorinated alkane) not taught in Applicants' Claims. Applicants respectfully assert the emulsion of Applicants' Claim 1 cannot be used to provide the coated ink jet nozzle of Diaz, and further the emulsion of Applicants' Claim 1 provides advantages in processing, adhesion, and resistance to abrasive and alkaline conditions over Diaz.

Albinson discloses that a two-step process is advantageous to coat an ink jet recording head, thus two distinct layers are prepared. Two steps and two layers are taught to be necessary to achieve good abrasion resistance and resistance to solvent attack (Albinson, column 3, lines 15-39). Thus, Applicants' claims wherein a single coating step, that is, using an emulsion of composition defined in Claim 1, is used to coat a conduit resistant to abrasive and alkaline conditions, such as an ink jet recording head, providing good adhesion, and resistance to abrasive and alkaline conditions provides advantages over Albinson.

Griffin discloses use of fluorocarbon silane compositions to coat the surfaces of ink jet nozzles to resist wetting by liquid in an ink. Griffin teaches that "conventional" fluorocarbon silane compositions lack good adhesion to the surface of various substrates, including those of Albinson (page 2, lines 1-9). Griffin teaches particular combinations of crosslinked copolysiloxanes and surfaces provide adhesion and resistance to wettability. For example, Griffin teaches use of copolysiloxanes having –COOH groups to bond with glass and metal surfaces and use of copolysiloxanes having Zerewitinoff hydrogen atoms, such as ENH2, ENHE', ECONH2, ECONHE', where E and E' are alkylene groups containing two or more carbon atoms, with polyimide substrates. Applicants respectfully assert that the emulsion compositions used to coat the conduit of Applicants' Claims do not require either –COOH groups or Zerewitinoff hydrogen atoms, as indicated by the Examples, yet good adhesion has been observed after abrasion testing and cleaning in an ultrasonic cleaner. Thus, Applicants assert the conduit of Applicants' Claim 1 has unexpected abrasion resistance and resistance to alkaline conditions in view of Griffin.

Thus, each of Diaz, Albinson, and Griffin, teach that not all fluorocarbon-silane compositions are effective for use in demanding environments such as ink jet nozzles where abrasive and alkaline conditions are present.

Applicants assert there is also lack of motivation to combine Iwato and Diaz when considered in light of the teachings of Nakagawa. Applicants respectfully direct Examiner to Nakagawa at page 3, paragraph [0008], which states, "[A] conventional water-repellent film using a silane coupling agent lacks durability against alkalinity." Furthermore, Nakagawa discloses at page 3, paragraph [0009] that a conventional film using a silane coupling agent, which bonds to a surface through Si-O bonding, lacks durability because the Si-O bond is hydrolyzed easily in alkaline solution. Thus, there is no motivation to select the emulsion of Iwato, which includes a fluorocarbon silane coupling agent, to coat a conduit which may be exposed to alkaline conditions, such as an ink jet nozzle.

Furthermore, Nakagawa suggests that a coating solution similar to the emulsion disclosed by Iwato and according to Applicants' Claim 1 would not be effective to provide a coating in an ink jet head that is resistant to alkaline conditions. Nakagawa discloses a coating solution comprising a fluorocarbon silane, water, a silicon compound and an acid - see page 13, Comparative Example 2 where the fluorocarbon silane is (2-perfluorooctyl)ethyltrimethoxysilane, which is $CF_3(CF_2)_7CH_2CH_2Si(OCH_3)_3$; the silicon compound is tetraethoxysilane and the acid is hydrochloric acid - fails to provide resistance to alkaline conditions. Applicants' fluorosilane has formula R_f-$(CH_2)_p$-Si{-$(O$-$CH_2CH_2)_n$-OR^1}$_3$; said R_f is a C_{3-18} perfluoroalkyl group or combinations of two or more thereof; each R^1 is independently one or more C_{1-3} alkyl groups; p is 2 to 4; and n is 2 to 10.

When a substrate coated with the composition of Nakagawa's Comparative Example 2 was exposed to an alkaline ink, the coating (film) was dissolved (see page 18, Table 1). Therefore, Nakagawa suggests a composition, that is, similar but for the fluorocarbon silane formula, as defined in Applicants' Claim 1 is not resistant to abrasion by alkaline inks. Nowhere is it taught or suggested that the particular composition of the emulsion of Applicants' Claim 1 would be effective to provide resistance to abrasion and alkaline conditions. Therefore, Applicants assert there is no motivation to use the emulsion composition disclosed by Iwato which shows heat resistance and water-repellency properties to for coating a conduit exposed to abrasive and alkaline conditions.

Thus, each of Diaz, Albinson, Griffin, and Nakagawa teach that not all fluorocarbon-silane compositions are effective for use in demanding environments such as ink jet nozzles where abrasive and alkaline conditions are present.

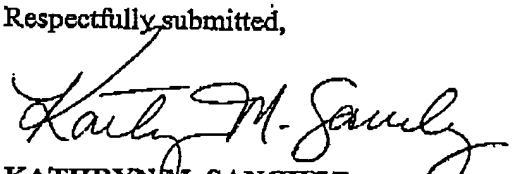
Surprisingly, in light of the teachings of Diaz, Iwato, Albinson, Griffin and Nakagawa, when a conduit is coated with the emulsion composition described in Claim 1, the conduit has good resistance to abrasion and alkaline conditions as disclosed by abrasion testing and, in Example 1, in actual use in an ink jet printer. The conduit as claimed having at least a portion of its surface coated with a layer produced from the emulsion composition as described in Applicants' Claims surprisingly shows good adhesion, good abrasive resistance and good performance when the conduit is a nozzle used in an industrial ink jet printer (see Example 1, page 6, lines 16-24) in view of the teachings of Diaz, Iwato, Albinson, Griffin and especially Nakagawa. Therefore, Applicants respectfully assert that the particular conduit as coated with the emulsion composition and process to prepare a coated conduit as defined in Applicants' Claims and shown in the Examples is not obvious based on Diaz in view of Iwato.

Examiner further asserts, with regard to Claims 3-4, providing Applicants' thickness, absent evidence of unexpected result, is obvious and within the level of one of ordinary skill in the art through routine experimentation. Examiner concludes it would have been obvious to one of ordinary skill in the art to provide claimed thickness in order to achieve improved heat resistance and water repellency properties and/or reduce costs. Applicants respectfully assert Claims 1-2 as amended are not obvious. It is surprising that the particular emulsion defined in Claim 1 comprising provides excellent abrasion resistance and resistance to alkalinity in view of the prior art discussed hereinabove. Therefore, Claims 3-4 which depend on Claims 1-2 are also not obvious.

Conclusion

For the foregoing reasons and discussion, Applicant respectfully requests that the rejections be withdrawn, and respectfully requests that a patent be issued on these claims. Should any questions arise, the Examiner is invited to contact Applicant's attorney at the number noted below.

Respectfully submitted,



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Dated: July 13, 2006